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EXAMINER	
TRINH, THANH TRUC	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/778,009	Applicant(s) SCHER ET AL.	
	Examiner THANH-TRUC TRINH	Art Unit 1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09 February 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *104-111,113-140 and 286-300* is/are pending in the application.

4a) Of the above claim(s) *286* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *104-111,113-140 and 287-300* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *7/16/04, 7/27/04, 2/9/09*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Remarks

1. Claims 104-111, 113-140 and 286-300 are pending. Claim 286 is withdrawn from consideration. Claims 104-111, 113-140 and 287-300 are examined below.

2. IDS dated 7/16/2004, 7/27/2004 and 2/9/2009 have been considered and signed. Copies of signed IDS should be attached along with the Office Action. There is no IDS dated 7/14/2004 or 7/23/2004 found.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. Claims 104-111, 113, 115, 118-119, 121-128, 130-133, 137-138 and 287-300 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nelles et al. (US 2002/0117201) in view of Salafsky et al. (US Patent 6239355).

Regarding claims 104-106, 110, 113, 115, 292-294 and 300, Nelles et al. teaches a photovoltaic device comprising a first electrode layer and a second electrode layer (e.g. electrode materials, EM; see paragraphs 0018-0029); a first photoactive layer (HTM/dye/SOL, or HTM/SOL) disposed between and in contact with the first and second electrode layers, wherein the photoactive layer comprises two sublayers of nanostructures such as TiO_2 nanocrystals (or SOL layer, see paragraph 0047) and a small molecule (or HTM layer) such as TPD (see paragraph 0037). The small molecule (e.g. TPD – N,N'-diphenyl-N,N'-bis-(3-methylphenyl)-(1,1'diphenyl)-4,4'-diamine) is a hole transporting material that can be used alone (see paragraph 0037); therefore it is the Examiner's position that the small molecule is a semiconductive molecule other than a dye, an organic nonpolymeric molecule and the photoactive layer is free of conductive polymer.

The difference between Nelles et al. and instant claims is the requirement of discrete nanostructures, or single-crystal nanostructures.

Salafsky teaches the TiO_2 nanostructures (204) are discrete nanostructures to form a photoactive channel architecture without requiring a passage to other nanoparticles. (See abstract and col. 4 lines 3-31).

It would have been obvious to one skilled in the art at the time the invention was made to modify the device of Nelles et al. by using a population of discrete

nanostructures as taught by Salafsky, because Salafsky teaches such population would provide a photoactive channel architecture without requiring a passage to other nanoparticles (See abstract and col. 4 lines 3-31 of Salfasky)

Regarding claim 107, the molecular weight of TPD is 516.67.

Regarding claim 108, TPD conducts holes (See paragraph 0037 of Nelles).

Regarding claims 109, 111, 287 and 295, as seen in Figure 2, Salafsky teaches the nanostructures (e.g. 204) disposed in a hole conducting material (e.g. 202). Nelles et al. teach the hole conducting material comprising a small molecule such as TPD in an admixture of nonconducting polymer. (See paragraph 0037 of Nelles et al.). In the combination of Nelles et al. in view of Salafsky, it would have been obvious that the nanostructures are disposed in a matrix comprising the small molecule dispersed in a nonconductive polymer.

Regarding claim 118, Nelles teaches the photoactive layer is disposed in at least partial electrical contact with the first electrode along a first plane (e.g. EM/HTM plane or EM/SOL plane) and with the second electrode along a second plane (e.g. EM/SOL or EM/HTM plane). Salafsky also teaches the photoactive layer (e.g. 106) is disposed in at least partially electrical contact with the first electrode (104) along a first plane and with the second electrode (108) along a second plane. (See Figures 1-2 of Salafsky).

Regarding claim 119, as seen in Figure 2, Salafsky describes the nanostructures (204) of the first population each has at least one elongated section oriented predominantly normal to at least the first plane.

Regarding claims 121-122, as seen in Figure 3, Salafsky discloses a hole blocking layer (301 disposed between the photoactive layer (106) and the first electrode (104), and electron blocking layer (302) disposed between the photoactive layer (106) and the second electrode (108 - See col. 5 lines 25-56). It would have been obvious to one skilled in the art to incorporate the blocking layers as taught by Salafsky in the device of Nelles et al. in view of Salafsky, because Salasky teaches such blocking layers would allow only one charge carrier type to pass to the underlying contact and thereby reduces charge recombination at the electrode-photoactive layer interface. (See col. 5 lines 43-56).

Regarding claims 123-124, Nelles et al. teaches the first and second electrodes and the photoactive layers are flexible (See paragraphs 0035-0047 of Salafsky). Salafsky also describes the electrodes and the photoactive layers are flexible (see claim 11 of Salafsky).

Regarding claim 125, Nelles et al. teaches at least one of the first and second electrodes comprises a transparent conductive layer (see paragraphs 0021, 0035 of Nelles et al.). Salafsky also discloses at least one of the first and second electrodes comprises a transparent conductive layer (See col. 6 lines 26-31 of Salafsky)

Regarding claim 126, Nelles et al. teaches at least one of the electrodes comprises aluminum (see paragraph 0035 of Nelles et al.). Salafsky also discloses at least one of the electrodes comprises aluminum. (See col. 6 lines 26-31 of Salafsky).

Regarding claim 127, as seen in Figure 1, Salafsky describes the electrodes (104 and 108) covering the top and bottom layers of the photoactive layer (106). Therefore it

would have been obvious to have the photoactive layer (106) is hermetically sealed by the electrodes (104 and 108) as taught by Salafsky.

Regarding claim 128, Nelles et al. teaches using the substrate covering the electrode (e.g. EM as seen in paragraphs 0018-0029). Salafsky also teaches substrate 102 covering the first electrode 104. Therefore it is the Exmainer's position that the device of Nelles et al in view of Salafsky comprises at least one sealing layer (102) in addition to the first and second electrodes.

Regarding claims 130-131, Nelles et al. teaches the photovoltaic device is flexible (see paragraph 0046 of Nelles et al.). Salafsky describes the photovoltaic device can be curvi-linear or mechanically flexible col. 6 lines 41-60). Therefore it is the Examiner's position that the overall device comprises a non linear architecture or a convex architecture.

Regarding claims 132-133, Nelles et al. in view of Salafsky does not specifically teach the photoactive layer and the electrodes are oriented in a coiled architecture, or in a reciprocating stacked architecture. However, Nelles et al. teaches the photovoltaic device is flexible (see paragraph 0046 of Nelles et al.). Salafsky describes the photovoltaic device can be curvi-linear or mechanically flexible col. 6 lines 41-60) to be suitable for building applications among others (See col. 6 lines 41-46). Salafsky also teaches the photoactive material layer are in the range of nanometers, wherein the semiconductor particles have an average diameter about few nanometers to hundreds of nanometers (See col. 4 lines 54-63) and the and conjugated polymer has a thickness in the range of one to two times the average diameter of the nanoparticles. (See col. 2

lines 46-53). It is the Examiner's position that the device is flexible and bendable since the substrate, electrodes are flexible and the photoactive material layer is thin enough to be flexible. Therefore, it would have been obvious to one skilled in the art to have the device of Salafsky in coiled architecture. Salafsky also teach the layers electrodes and photoactive material layers can stacked up as seen in Figure 3. Therefore it certainly would have been obvious to one having ordinary skill in the art to have the device of Salafsky in reciprocating stacked architectrure.

Regarding claims 137-138, as seen in Figure 3, Salafsky discloses a second photoactive layer (308) disposed between and partially electrical contact with a third electrode layer (306 and 307) and a fourth electrode layer (310 and 312). The second photoactive layer comprises a second population of nanostructures having a different absorption spectrum from the first population of nanostructure (See col. 5 line 57 through col. 6 line 4), and wherein the third and fourth electrodes and second photoactive layer are attached to, but electrically insulated by isolation layer 304 from the first electrode (e.g. 104), second electrode (e.g. 108) and first photoactive layer (e.g. 106). (See col. 5 line 26 through col. 6 line 4).

Regarding claims 288-291 and 296-299, Nelles et al. teaches the small molecules such as hole transporting material TPD can be used alone or in a mixture with polymers (e.g. non-conductive polymers, see paragraph 0037). Therefore it would have been obvious to one skilled in the art to select a workable and optimal range of the mixture of hole transporting material and TPD (e.g. the weight percent of the small

molecule being greater than 50%, greater than 75%, greater than 90%, or greater than 95% in the matrix).

4. Claims 104, 116-117 and 120 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nelles et al. in view of Salafsky and further in view of Alivisatos et al. (US 2003/0226498)

Nelles et al. in view of Salafsky teaches a photovoltaic device as applied to claims 104-111, 113, 115, 118-119, 121-128, 130-133, 137-138 and 287-300 above.

Nelles et al. in view of Salafsky does not specifically teaches the nanostructures comprise nanowires, at least a portion comprises a semiconductor selected from the group consisting of a Group II-VI semiconductor, a Group III-V semiconductor, a Group IV semiconductor; nor do they teach branched nanocrystals having more than one elongated segment.

With respect to claim 114, Alivisatos et al. teach nanostructures comprises nanorods of any length, or nanowires. (See paragraph 0061)

With respect to claim 116-117, Alivisatos et al. teach the nanostructures comprise a Group II-VI semiconductor such as ZnS, ZnSe, ZnTe, CdS, CdSe, CdTe, HgTe, a Group III-V semiconductors such as GaAs, GaP, GaAs, GaSb, InAs, InP, InSb, AlAs, AlSb, and a Group VI semiconductors such as Ge or Si. (See paragraph 0065).

With respect to claim 120, Alivisatos et al. also teach the nanostructures comprise branched nanocrystal having more than one elongated segment. (See paragraphs 0061-0064)

It would have been obvious to one skilled in the art at the time the invention was made to modify the device of Nelles et al. in view of Salafsky by using nanostructures as taught by Alivisatos et al., because it would improve efficiency. (See paragraph 0073)

5. Claim 129 and 134-136 rejected under 35 U.S.C. 103(a) as being unpatentable over Nelles et al. in view of Salafsky, and further in view of Simmons et al. (5720827).

Nelles et al. in view of Salafsky teaches a photovoltaic device as applied to claims 104-111, 113, 115, 118-119, 121-128, 130-133, 137-138 and 287-300 above.

Nelles et al. in view of Salafsky does not specifically teach the second sealing layer, wherein the photovoltaic layer and first and second electrodes are sandwiched between the first and second sealing layers. Nelles et al. in view of Salafsky also does not specifically teach the first population of nanostructures comprising at least two different nanocrystal subpopulations, wherein each nanocrystal subpopulation has different absorption spectrum; different nanocrystal subpopulation comprises different compositions; different nanocrystal subpopulations comprises nanocrystals having different size distribution.

With respect to claim 129, Simmons teaches using sealing layers 38 and 40, wherein the photovoltaic layer 20 and electrodes 34 and 36 are sandwiched between the sealing layers 38 and 40. (See Figure 3, col. 8 line 3 through col. 9 line 40)

With respect to claims 134 and 136, as seen in Figure 2, Simmons teaches a nanostructure population (or photoactive region 20) comprises at least two different nanocrystal subpopulations (22, 26, 28, 30, 32), wherein the subpopulations have

different size and each subpopulation has different absorption spectrum. (See col. 5 lines 45-65 and col. 7 line to col. 8 line 15 of Simmons)

With respect to claim 135, as seen in Figure 5, Simmons teaches a nanostructure population (or photoactive region 20) comprises at least two different nanocrystal subpopulation (20A and 20B), wherein each subpopulation comprises different compositions, or different material. (See col. 13 lines 13-50 of Simmons).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the device of Nelles et al. in view of Salafsky by including a sealing layer as taught by Simmon, because it would cover the electrodes and photoactive layer from external elements. (See col. 8 lines 21-26). It would certainly have been obvious to one skilled in the art at the time the invention was made to modify the device of Nelles et al. in view of Salafsky by including at least two different nanocrystal subpopulations with different size, composition and absorption spectrum as taught by Simmons, because it would give a photoactive layer that can efficiently absorb the entire range of incident optical radiation. (See col. 8 lines 14-16)

6. Claims 139-140 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nelles in view of Salafsky, and further in view of Ono (PGPub 20030013008).

Nelles et al. in view of Salafsky teaches a photovoltaic device as applied to claims 104-111, 113, 115, 118-119, 121-128, 130-133, 137-138 and 287-300 above.

Nelles et al. in view of Salafsky does not specifically teach a third electrode layer and a second photoactive layer disposed between the second and third electrodes

layers, wherein the second photoactive layer is disposed in at least partial electrical contact with the second electrode and in at least partial electrical contact with the third electrode. Nor does he teach a second photoactive layer, and a first recombination material disposed between the first and second photoactive layers, wherein the first recombination material is in at least partial electrical contact with the first and second photoactive layers.

As seen in Figure 21(d), Ono describes a composite light-receiving device comprising a first and second photoactive layers (710 and electrolyte which can be a conductive polymer – See paragraph 0261 and 0119-0122) disposed on a conductive substrate (700), a third electrode (800), which is also the first recombination material in claim 140, disposed between the first and second photoactive layers. In other words, the second photoactive layer is disposed in at least partial electrical contact with the second electrode and in at least partial electrical contact with the third electrode, or the first recombination material (or electrode 800).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the device of Nelles et al. in view of Salafsky by including a second photoactive and a third electrode (or a first recombination material) as taught by Ono, because it would provide a device that can response to different types of light. (See paragraphs 0012 or 0216). It would certainly have been obvious to one skilled in the art that in the combination of Nelles et al. in view of Salafsky and Ono, the second photoactive layer is disposed in at least partial electrical contact with the second electrode and in at least partial electrical contact with the third electrode.

Response to Arguments

Applicant's arguments with respect to claims 104-111 and 113-140 have been considered but are moot in view of the new ground(s) of rejection. Applicant argues that Den does not teach limitations as claimed. However, Applicant's argument is directed to the amended limitation which is moot in view of the new ground(s) of rejection. As seen in the rejection above, Nelles et al. in view of Salafsky teaches a first electrode layer, a second electrode layer, a first photoactive layer disposed between and in contact with the first and second electrode layers, wherein the photoactive layer comprises discrete nanostructures such as TiO_2 nanocrystals (or SOL layer, see paragraph 0047) and a small molecule (or HTM layer) such as TPD (see paragraph 0037). The small molecule (e.g. TPD – N,N'-diphenyl-N,N'-bis-(3-methylphenyl)-(1,1'diphenyl)-4,4'-diamine) is a hole transporting material that can be used alone (see paragraph 0037); therefore it is the Examiner's position that the small molecule is a semiconductive molecule other than a dye, an organic nonpolymeric molecule and the photoactive layer is free of conductive polymer.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to THANH-TRUC TRINH whose telephone number is (571) 272-6594. The examiner can normally be reached on 8:30 am - 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, NAM NGUYEN can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Nam X Nguyen/
Supervisory Patent Examiner, Art Unit 1753

TT
6/1/2009